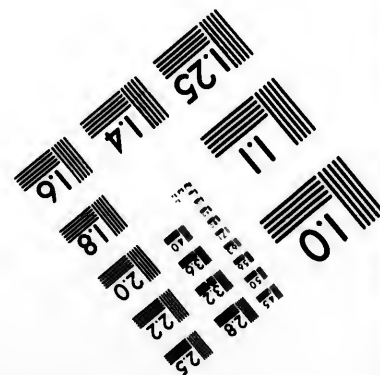
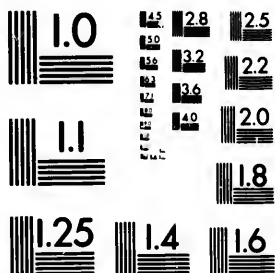


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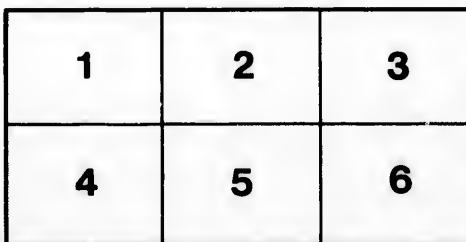
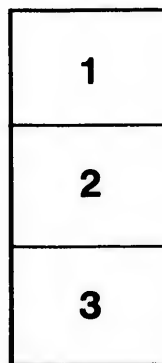
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RAILWAY ACCIDENTS,

BY

A. T. DRUMMOND,

A. CAN. SOC. C. E.

BY PERMISSION OF THE COUNCIL.

EXCERPT MINUTES OF THE TRANSACTIONS OF THE SOCIETY.
VOL. II. PART. I. SESSION 1888

Montreal:

PRINTED BY JOHN LOVELL & SON.



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Canadian Society of Civil Engineers.

8th March, 1888.

H. WALLIS, Member of Council, in the Chair.

RAILWAY ACCIDENTS AND A RAILWAY COMMISSION.

By A. T. DRUMMOND, A. CAN. SOC. C. E.

Railways are now such important factors in the convenience and prosperity of every community, that whatever improvements will tend to diminish the danger of loss of life upon them must be of public interest. Whether every railway accident is preventable is open to question, for after all the improvements with which human device has aided railway construction and equipment, and after all the care and foresight which able men have exercised on the best constructed roads, accidents, unaccountable, will happen to both passengers and employees. And yet, seldom a month passes, but some other appalling catastrophe, proved to be due to oversight or negligence on the part of the employees, or to defects in the roadway or the rolling stock, convinces us of the absolute necessity on every railway of stringent management, careful inspection, and proper material and workmanship. During the past year, accidents both in the United States and Canada, leading to heavy loss of life, have once more forcibly drawn public attention to the subject, and in the United States, railway commissions have been recommending and legislatures have been enacting, more stringent laws with a view to, if possible, prevent such terrible fatalities in the future.

The vast extension of the railway system in the United States has led there to greater inquiry into the condition of railways, to more systematic oversight, and, at least in the older States, to more legislation regarding railway construction and railway management than exist in Canada. Permanent railway commissions have been appointed in twenty-one of the States, including each of the Northern States, excepting Indiana and Vermont. Some of these commissions are the result of relatively recent legislation, but others have been in operation for many years. The effect of these appointments has been that closer attention is now paid to the wants of the public in the service of the trains, in the establishment of rates, and in the safety of the roadway, bridges and rolling stock; minute details are furnished of the equipment and the operating of each railway system; and every serious accident occurring within the borders of several of these States is closely investigated to ascertain its cause with a view to prevention in the future.

pleasant chapters to read, and must convince every one that much requires yet to be done to render travelling as safe as it can be made. It may be said that not a few of these accidents arise from the culpable carelessness of the parties injured, but this makes it all the more necessary that laws should be made to, if possible, protect men even against their own carelessness.

The statistics of railway accidents in Canada, after making all allowances which may be claimed, appear not to be as favourable to our railways as they might be. Under any view which may be taken, they convince us that much can yet be done for the safety of the railway employees as well as of travellers. The two years selected for illustrating, as far as the official returns will admit, the passenger traffic and accidents in Canada and some of the leading states of the Union, are given, not merely because the statistics are the most recently published, but because they may be taken as representing results under the favourable circumstances of the newest regulations and the most recent appliances adopted by the railways to secure safety. The selection is not unfair to Canada, as the returns of these two years here compare very favourably with the average of the last ten years, though the poverty of the passenger traffic suggests either some error or a remarkable domesticity among the Canadian people. The particular states selected have been chosen at random, with this qualification that in each of these states there has been a railway commission at work for some years. In all such railway statistics, however, the grave defect which detracts from their value for the purposes of comparison, is the lack, in the different states, of a uniform system of collecting these statistics.

Year.	State or Country.	Passengers carried. (with reserve.)	Killed or injured.	
			Passengers.	Employees and others.
1885	Massachusetts ...	69,603,700*	74†	443†
1886	do ...	75,842,581*	107†	476†
1885	Connecticut.....	17,430,921*	12†	222†
1886	do	19,011,381*	42†	297†
1885	New York.....	73,555,179*	112	1435
1886	do	81,463,709*	125†	1516†
1885	Ohio.....	32,895,641*	78	1061
1886	do	31,781,707*	49†	911†
1885	Illinois	20,593,478†	145†	1318†
1886	do	22,727,934	6†	1254†
1884	Michigan	24,782,322*	36†	459†
1885	do	22,970,564*	36†	403†
1885	Canada	9,672,599	84	757
1886	do	9,861,024	79	636

* Includes the total returns of the entire lines of the through railways.

† Includes only returns properly referable to the particular state.

Whilst the railway accidents in Canada seem to be numerous, it would be hardly fair to form even general comparisons from the above statistics. It is, in fact, most difficult to arrive at any fair comparison between the results of railway travelling in Canada and those in the United States. The general returns covering the whole United States are not all official, and are not all collected under the same system and with the same attention to correctness and detail which in several of the Northern States characterise the official returns. On the other hand, these official returns are at times equally unserviceable to the statistician, because the great through lines appear sometimes to return to each State the total passengers or total accidents, instead of confining the numbers to those referable to the particular State to which the returns are made. Comparisons are thus without any exact value. Again, in Canada, the passenger mileage is not given in official reports. In the State official reports, it is not unusual to find the safety of railway travelling judged in a general way by the proportion which the passenger accidents bear to the whole number of passengers carried. For reasons already given, this sometimes might lead to an exaggeration. The passenger mileage, on the other hand, has been thought by many to afford a more correct basis, because it admits more particularly of suburban travel being considered. Suburban travel, however, arises from enlarging cities and a more dense population surrounding them, and has associated with it increased elements of danger in more frequent and more crowded trains on the same tracks and at the hours when the ordinary passenger traffic is greatest, more crowded platforms, more level crossings and greater proportionate traffic across them, more employees and more trespassers on the tracks. If in the carrying of suburban passengers safely, employees or others are killed or injured, another element of importance has to be considered by those who would gauge safety simply by the passenger mileage. To illustrate this, the Michigan Central Railway operates 1514 miles of road, of which only 49 are in Illinois. Now, while the total accidents on the whole line for 1885 and 1886 averaged 149, those for Illinois alone averaged 27.

The statistics of the Canadian railways do not give the number of employees, and it is impossible to institute any comparison between the number killed or injured and the whole number employed. Apart from this, however, the returns of accidents to employees do not appear favourable on the Canadian railways, nor, further, do the similar returns from the railways in the above States of the Union. It may be urged that many of the accidents on the Canadian roads arise from trespassers walking on the track, etc., but on some American railways

a larger proportion of accidents is due to this cause. And the life of an employee is as valuable as that of a passenger.

The analysis of the causes of accidents in Canada is not so full as it might be in the government returns, but for the two years 1885-6, the following results appear:

	1885.	1886.
Falling from engines or cars,	125 (8 being passengers)	75 (8 being passengers)
Jumping on or off trains,	64 (24 do)	65 (16 do)
Making up trains,	20	10
Putting head or arms out of windows,	3	1
Coupling cars,	285	222
Collisions or derailment,	97	89
Trespassers on track,	153	135
Striking overhead bridges,	10	8
Explosions,	2	0
Other causes,	82	110 (98 being employees)
	841	715

In the case of a large number of accidents on their lines, railway companies are in no wise responsible. Many arise simply from the existence of the railway and the carelessness of the injured. Whilst however it may be impossible to prevent every accident, a humanity common to us all impels us to agree with the Massachusetts commissioners in their more than once expressed conviction that a preventable accident is a crime, and forces us to feel that every known precaution and every admittedly successful remedy with which railway men are familiar should be imperatively adopted in the endeavour to lessen this loss of life and this injury to passengers and employees.

The subject naturally leads to a consideration of certain safeguards, which the experience of railway commissions and of some of the leading American railways has suggested as necessary on every properly equipped road, and which have equally commended themselves to some Canadian engineers and railway officials as improvements still imperatively needing introduction on some Canadian railways. To the unprofessional public they will all appear as of the first importance. In some of the Northern States, certain of these safeguards have, in either an absolute or qualified way, been made the subjects of legislative

enactment, and there seems no reason why, in Canada, some of them regarding whose importance there is no division of opinion, might not equally be given the force of parliamentary sanction. But why will not railways view improvements from a business point? A derailment on a bridge unprotected by guards, or the burning of a train furnished with stoves, may occasion such injury and loss of life, that the claims made and the damage done to the line and equipment would ten times over pay for the improvements, which would have averted the disaster, as well as for many such improvements over the whole line.

BRIDGES AND EMBANKMENTS.

GUARD RAILS.—On all embankments exceeding a certain height, and on all bridges and viaducts, there should be on the outer side of each rail of the main line, guard rails or guard timbers, faced with angle iron, and securely bolted to the ties underneath, and these guard rails or guard timbers should be continued for a short distance on each side of the bridge, viaduct, or embankment. The object of the guard rails is to prevent the cars from entirely leaving the track at these dangerous points.

Between the main line rails on all bridges and embankments, and the approaches thereto, there should be guard rails, forming a somewhat curved V, so securely placed as to guide the wheels, when off the track, back to the main line.

Every bridge should have a floor system strong enough to support a derailed locomotive or car in motion.

Under the Connecticut laws of 1878, the commissioners were empowered to order guard rails to be placed on the bridges and trestles.

In 1881, the Massachusetts commissioners accompanied a circular on the subject, with two sheets of illustrations of various improved forms of track construction in actual use on bridges in that state and elsewhere. Among these, the Sabula bridge on the Chicago, Milwaukee and St. Paul Railway, affords the best illustration of an earnest endeavour to secure safety by an efficient flooring. Not only are there guards faced with angle iron on both sides of each steel rail, with a flooring of $\frac{3}{8}$ " plate iron between, upon which derailed wheels can run, but outside of all on each side of the bridge and near the trusses are, securely bolted down, 10" square longitudinal stringers as a further protection. On the approaches to the bridges, the commissioners suggest not only the curved V rail between the main line rails, but, instead of guard timbers, outside guard rails which gradually flare out beyond the ends of the bridge to a width of 12 feet.

The Dedham disaster revealed the fact that the bridge there had no suitable guard rails, that the floor system was not sufficient, and that the bridge had not even been tested.

On very high embankments, these guard rails are of almost as great necessity as on bridges and their approaches, so considerable would be the fall in the event of complete derailment of a train.

Guard rails are often neglected on our Canadian roads, and when they are present, are not usually faced with angle iron. Probably on no Canadian lines are plate iron floorings found between the rails, and yet, in the event of derailment, it is not difficult to see the great importance of such floorings placed over closely laid ties, in conjunction with the V shaped guards between the main rails. The Latimer bridge guard, which really comprises steel rail guards placed in this V shape, with a gradually rising floor piece on either side of each rail of the main line, is directly known to have saved terrible loss of life and property in February, 1885, on the New York, Pennsylvania and Ohio Railway, at the Lyon Brook iron viaduct, which is 165 feet high and 800 feet long. Here an express train, running at thirty miles per hour, was brought back to and kept on the track, notwithstanding a broken tire and derailed truck of the engine. The Ohio commissioners report most favourably on the Latimer guard.

BRIDGE INSPECTION.—There should be frequent, periodical, careful inspections of all bridges, whether of iron or wood, by competent officials, and unless pronounced safe, no trains allowed to cross at a high speed.

There is an absolute necessity that all bridges constructed years ago, when railways had lighter engines and cars, and each car carried a smaller load than now, should be reconstructed, with a view to increasing the strength to the new requirements. Particularly is this the case with those short roads, which the exigencies of competition and consolidation have transformed into parts of great through lines between great commercial centres, and which have in consequence become burdened with heavy traffic. It is, in such cases, equally a necessity that the track should be renewed with heavier steel rails. The engines and the loads carried on each freight car are now often double what they formerly were.

The New York commissioners have gone farther than others in the inspection of bridges and trestles. They correctly assume that bridge foremen—however otherwise competent—have not the technical education which enables them to properly inspect bridges. They have, therefore, insisted not only on inspection by themselves or their representatives but on drawings being furnished of all truss railroad bridges in the

state, showing their construction and dimensions and the floor system adopted. These drawings are required to be accompanied by a strain sheet showing the strain on each member produced by the maximum moving load allowed on the bridge. These strain sheets are carefully gone over by the commissioners. It has been observed by them that rolling loads from cars alone sometimes reach 3600 lbs. per running foot.

After the terrible Dedham disaster, last winter, it was ascertained that the bridge had year after year been examined by the same man, who was a mere machinist.

OVERHEAD BRIDGES.—Every bridge forming part of the line of the railway, every bridge crossing the track, and the roof of every tunnel and snowshed, should be so constructed that at least seven feet should intervene between the roof of the highest freight car and the lowest point of the bridge over head or the roof of the tunnel or snowshed. This precaution is in the interest of brakemen on freight trains, many of whom when on duty have been killed by their heads striking against the bridge timbers above them. The Dominion Railway Act, provides for this height above the car, but accompanies the provision by a saving clause, which practically prevents it from operating, except on the newer roads. If all freight cars were provided with power brakes, controlled by the engine driver, there would be less necessity for brakemen being on the roofs of cars and less necessity therefore for this provision.

The Ohio commissioners appear to aim at having the lowest point of the roof at least 18 feet above the track. The Connecticut commissioners were given power to require every railway to erect and maintain suitable warning signals, at every bridge less than 18 feet above the track, whilst the New York Act of 1884, made the placing of these warning signals directly imperative on every railway. Warning signals are however unsatisfactory, because liable to go out of order. Suspended cords not only rot and fall off, but in the event of a gale blowing in the same direction with the moving train, might never be noticed by the brakeman. The correct principle is to have the lowest point of the roof sufficiently high above the cars to admit of a man moving freely on the top of the cars.

FREIGHT CARS.

POWER BRAKES ON FREIGHT CARS.—Freight cars should be furnished with automatic power brakes. This would be a great boon to the trainmen, besides being more effective and economical than the present system. The brakeman on freight trains has a very hazardous occupation, more particularly during the winter

season, when with the train in motion and the cars swaying from side to side, he has frequently, in the course of his duty, to run from car to car along their often slippery roofs. The numerous deaths and injuries annually arising from brakemen falling from the cars, could be largely avoided by the use of power brakes, whilst economy would result from the employment of fewer men. Power brakes are in use in the United States, on the Pacific roads, the Denver and Rio Grande, the Pittsburg, Cincinnati and St. Louis, the Chicago, Burlington and Quincy, and the Atchison, Topeka and Santa Fe railways. The difficulty may be urged as in the case of couplers, that on through lines they cannot be brought into use unless adopted by all connecting lines as well, but surely railway men, if united in opinion of the value of power brakes, can overcome this difficulty when economy of service is the result, unless they are waiting for impossible ideals in these brakes.

RAILINGS.—The New York commissioners suggest that a low railing should be placed on the roof along the centre, lengthwise of the freight car, so that in the event of slipping, the brakeman could seize it, and probably save his life. As an additional safeguard, the central boards covering the apex of the car roof, should be extended somewhat beyond the ends of the car, so that with the similar extension on the next car, a bridge would be formed, and the brakeman spared the risk of a dangerous leap when running from car to car.

COUPLERS.—Automatic couplers which will not need to be guided by the hand into position, which will not require the brakeman to go between the cars and which will readily adjust themselves to other couplers, especially the old link coupler, should be adopted on all freight cars. The fact that in Canada nearly one-third of the whole casualties to passengers, employees and others on railways, arise from the coupling of cars, proves how pressing some remedy is required. In Massachusetts, it has been an increasing cause from year to year, until, in 1886, the casualties arising from it, were four times the number of ten years before. In Michigan, during the same year, the proportion of casualties ascribable to it, was between one-third and one-fourth of the whole. In other States the proportion was equally large.

In dealing with the question, the difficulty at once arises that unless all roads adopt either the same or an adjustable coupler which will suit any other coupler, the liability to the constant recurrence of casualties will continue. The railway commissioners of several States have given great attention to the subject, and, after careful trials, several automatic couplers embodying the above stated requirements have been selected by, among others, the commissioners of Michigan and Massachusetts. The selection includes the Janney, Hilliard, Cowell, United States,

Ames, Aikman, Perry and Marks couplers, and was made in view of the law passed by the legislatures of these States, requiring under a penalty the adoption of automatic couplers after a given date, on all new freight cars or cars under repair. Connecticut and New York State have passed similar laws, and the commissioners of the latter state have given the matter much thought. Whilst through the legislatures of leading States, taking up the matter in this way, other legislatures will undoubtedly soon follow, still some of the Railroad Commissioners are convinced that being also an interstate matter, Congress should take it up as well.

If the good points of several of the vast number of patented couplers could be combined in one, a perfect coupler might be had, but this could only be accomplished by purchasing the different patents. In the meantime, should these great casualties be allowed to continue because railways in their search for an ideal, practically impossible to obtain, ignore or cannot agree on the merits of several praiseworthy, well-tested couplers? Why should not railway managers confer and come to some conclusion on this pressing matter? Is not this also a fair subject for the Dominion Legislature to consider and act on?

The Master Car Builders' Association in the United States has more recently selected the Janney and those which couple with it, and it is to be hoped that where this association has influence good may result.

PASSENGER CARS.

TOOLS.—Each passenger car should be provided with, at least, axes, securely placed at either end of the car within glass casings. When cars are over-turned, it is generally most difficult to find appliances with which to get the imprisoned passengers quickly out. The glass casings prevent theft of the tools.

The New York State law of 1884 requires not only an axe to be provided, but also a crow bar, sledge hammer and hand saw—the whole under a heavy penalty.

TESTING OF WHEELS.—The wheels of the locomotive and cars of every passenger train should be tested every, say, sixty miles by a competent employee. This precaution is not so universal as it should be.

AIR BRAKES.—Every car intended to be attached to a passenger train should be provided with air brakes under which the motion of the train would be entirely under the control of the engine driver. The use of air brakes on passenger cars is almost universal, but the old

fashion hand brake is still seen on old rolling stock in use on accommodation trains and upon branch roads. The Canadian Act is so indefinite that if the power brakes were only on the wheels of the locomotive or of the tender, the law would be complied with.

The New York State law of 1884 excepts from its provision on this point any passenger car attached to a freight train where the speed does not exceed twenty miles per hour. When freight cars are furnished with air brakes this exception in favour of accommodation trains will be unnecessary.

ELECTRIC LIGHT.—Every car intended to be attached to a passenger train should be lighted by electricity or some other efficient source of light other than oil or other inflammable substance. It has been contended that oil which would stand 300° test is absolutely safe for the lighting of cars, but the proofs are by no means conclusive. It has been thought that a sudden shock which a derailment or a collision would give to the car would at once extinguish the lights, and remove the source of danger. The evidence is, however, rather to the contrary. Besides, the swaying of a Pullman car, in the event of derailment, would bring inflammable material like curtains and bedding into contact with the lighted lamps, and if they should take fire, such fire would find increased fuel should the oil from any of the lamps have become scattered over the car furnishings. Gas is not only open to the same objection but to the even greater objection that there is danger of explosion should the reservoir of compressed gas be burst open by the shock of a collision or otherwise. The only absolutely safe means of lighting, at present known, appears to be the electric light, and considerations of expense can alone prevent its general adoption. It does not add to the heat of the car, is under immediate easy control, has the advantage of cleanliness and freedom from unpleasant odors and gives a steady agreeable reading light. The Julian system has been introduced into Canada. Whilst, however, the daily cost per car—claimed to be \$1.83 per 24 lights for each ten hours,—will soon now be known beyond the range of mere experiment, the features which seem to still militate somewhat against its general use on all cars of passenger trains are the considerable first cost of the plant, the weight added to the car by the cells, and the necessary renewal of these cells every two or three years. And yet in railway economy, safety should be a vastly more important consideration than expense.

STEAM HEATING.—All cars intended to be attached to a passenger train should be provided with appliances for heating by steam generated in the locomotive, or by an efficient source of heat other than coal or

wood in stoves or heaters erected in or about such cars, or other fuel which would be liable, in case of accident, to communicate fire to the car. The pressing need for the abolition of the stove on passenger trains hardly requires to be discussed in view of the terrible fatalities from fire during the past two years. The New York and Massachusetts Commissioners have both in special reports condemned the use of the ordinary stove and the New York legislature has now passed an act in the same vein. The question remains—what efficient substitute can be applied whatever the climate may be? The Baker heater in use on the Pullman cars can it is contended be encased with an iron jacket which it would be practically impossible to burst open unless the whole car collapsed, but this is not actually established. It cannot be too often pointed out that it is not the ordinary, if the term may be used, but extraordinary accidents where the complete collapse of the cars is probable, that have to be the most guarded against, for where the loss of life is greatest. The very weight of a heavy heater is in itself an element of danger when the car is overturned at an embankment or bridge. The popular verdict, without doubt, is in favour of steam supplied as under the Martin system through a reducing valve from the dome of the locomotive. Various experienced railway managers and superintendents have, after actual trial, pronounced decidedly in its favour. The result of enquiries made by the Massachusetts and New York Railroad Commissioners appears to prove that the actual loss of power to the locomotive, ascertained from careful experiment, was insignificant, that the cost was little, if at all, more expensive than present methods, and that the heat could be stored for a considerable time after the steam was cut off.

It has been questioned if the system will work on railways with heavy gradients, but, even if the locomotive did there require all the steam, the cars once heated should remain comfortable for a considerable time without fresh steam—half an hour, the Martin system people claim, which would far more than suffice to overcome any ordinary grade. The objection that, on through trains, Pullman cars will be side tracked at points in the course of the journey is overcome by the fact that these are usually important points where the station buildings are already or can be with economy heated by steam which can be readily supplied to the side tracked cars. It has also been urged that the colder climate of Canada will interfere with the practical working of the system here, but it would be better if those who take this view would speak from an actual experience before detracting from the merits of a system which appears to produce a uniform pleasant heat under easy control, and which seems to possess the merits without the attendant risks of the

best car stove. Recent experiences in the severe weather of this winter have been decidedly in favour of steam heating.

Heating by steam is in successful use on the Cleveland, Columbus, Cincinnati and Indianapolis, Chicago and North Western, Chicago, Milwaukee and St. Paul, Dunkirk, Alleghany Valley and Pittsburg, Lake Shore, Boston and Albany, New York Central, Long Island, Staten Island Rapid Transit, New York Elevated and other railways, and its use has been inaugurated, experimentally, on the Intercolonial Railway.

PULLMAN UPPER BERTHS.—The upper berths of every sleeping car should be provided with such proper appliances other than wire attachments to the lower berths, as will in the event of accident to the car render it impossible for such berths to close whilst in use by passengers.

PASSENGER ACCOMMODATION.—Every railway should be compelled to furnish seating accommodation for all passengers. Especially on excursion and suburban trains is this necessary. The company should have no right to sell tickets to more parties than can be accommodated. There would then be no excuse for passengers crowding the platforms and blocking up the central aisles of the cars; and as at St. Thomas, on the London and Pt. Stanley Railway, intensifying the loss of life in the event of accident.

LOCOMOTIVES.

LOCOMOTIVE BOILERS.—Locomotive boilers should be subjected to test before going into service, and annually thereafter. The Truro and Stellarton explosions on the Intercolonial Railway are sufficient warnings of the necessity of this. The Massachusetts law of 1882 and the Commissioners' regulations under it, require not only boiler tests but special examinations, at least every three months, of the stay bolts, and an annual report of the results of these tests to the Commissioners.

SAFETY VALVES.—Locomotives should be provided with safety valves to prevent the escape of steam and scalding water in case of accident. The importance of this is shown by the Massachusetts Commissioners' statement in their 1887 report that 162 persons in six railroad accidents occurring in the United States within a year and a half, had been killed or seriously injured by scalding.

TRACKS.

BLOCKING FROGS.—It should be made compulsory on railways to adjust, fill or block the frogs, switches or guard rails in connection with

switches so as to prevent the feet of employes or others from being caught in them. Michigan and Massachusetts have laws providing for this.

LEVEL CROSSINGS.—With regard to level crossings already existing in the populous parts of towns and cities, a suggestive course is to make it the duty of the municipal councils to select such streets crossing the railway as it is desirable to have kept open at such crossings, and thereupon the railway company should erect gates at such selected crossings, and close up on either side of the track all other crossings. The expenses of erecting and maintaining the gates and of the gate-keeper should be borne in equal shares by the municipality and the railway company. Every town is bound to protect the lives of its citizens, and it is not right that the railway company which is such a factor in the progress of the place should bear the whole expense of this protection so far as rendered necessary by the entry of the railway, more especially when the crossings are often new streets opened since the construction of the railway. If the municipality has to bear one-half of the annual charge as well as of the first cost, there will be no desire to keep open unnecessary crossings and there will be a twofold interest in exercising care at the crossing kept open at the joint expense. At present the law gives a discretionary power to the Railroad Committee to direct changes in crossings and to apportion the cost, but practically, action has been seldom taken upon it. Canada has 7,241 level crossings.

In Connecticut the statute of 1883 provides that when a town desires a gate, flagman or electric signal at a crossing, this may be ordered, but the town may be directed to pay one-half the cost.

Those who urge the substitution of high level crossings or subways, little know the cost. It has been estimated by the Commissioners of Massachusetts, that such a substitution in every case of grade crossings in that State alone, would entail an expense nearly equal to the whole cost of the railways of that State. In Connecticut it is provided that new crossings must be either highways or subways, and if required by a town or municipality shall be built at the joint expense of the railway and it. Alterations in existing level crossings in the same State, where ordered, are also to be at the joint expense, but only one crossing per year was to be charged on any one railroad. These Connecticut laws are well worthy of consideration in Canada.

Where railways cross on the same level, the New York and Massachusetts laws require all trains to stop unless an inter-locking switch and signal apparatus is in operation there.

WALKING ON TRACK.—It should be made an offence punishable with a penalty to be found walking on a railway track, unless the offender is simply crossing the track, or is an employee then on duty. The need of stringent laws in this respect is seen in the fact that 299 persons were through this killed, and 171 injured, in all 470, in New York State, in 1886, 110 of these being employees and the others trespassers.

EMPLOYEES.

INTEMPERANCE. OVERWORK.—There are, affecting employees, two very important subjects which have each a direct bearing on the liability to accidents—intemperance and overwork. The one is within the control of the employee; the other within that of the railway corporation. The New York State law whilst providing for six months imprisonment or \$100 fine if an employee on duty is found intoxicated, also provides that any act or neglect of his when in that state, which shall occasion death or injury shall be punishable by imprisonment for a term not exceeding five years. The railway companies themselves can do much to prevent intemperance by prohibiting the sale or use of liquors on their premises.

Rest to employees is also a preventative of danger. How often is the mis-sent message or the mis-placed switch due to an operator or a switchman whose hours of service had been unduly prolonged! Sunday trains should also be discouraged as much as possible. The railway employee needs the rest of the seventh day as much as the merchant or the highest peer of the realm.

BOARD OF RAILWAY COMMISSIONERS.

The organization of railway commissions in the United States is the outgrowth of public opinion. Railways from being merely private enterprises have become necessary elements in the national prosperity. The unexampled advance made in their construction; the need of some state supervision in order to ensure as far as possible the safety of both passengers and employees, and the numerous local questions always arising between the public and the railway as well as between the different railways themselves, all created a necessity for a board representing the state which would have certain powers of control itself and would see that the State laws affecting railways were properly carried out. Railway companies as a rule have not desired the appointment of commissions. The managers from their stand point as representing private shareholders, naturally prefer, in the institution of improvements, to consider the means at their disposal; in the settlement of questions

with the public to suit their own convenience; and in the case of accidents and loss of life, to privately investigate the causes themselves.

The bare fact that the loss of life and the injuries, both to passengers and to employees on railways, is very considerable in Canada, is of itself a sufficient reason for a Railway Commission. The public has a right to enquire why casualties should occur, and equally a right to know whether needed remedies cannot be applied. At present there is a Railway Committee of the Privy Council clothed, under the Railway Act, with certain powers. The members of this committee are required to be members of the Dominion Government, but however able each in his own department is, he cannot lay claim to any special knowledge of the working of a railway. When references are made to the committee, the investigation and adjudications are made at Ottawa, dependence being placed on the reports of others and on the arguments of counsel. There is no personal inspection of the scene of the inquiry. Beyond the fact that the committee may appoint a commissioner in each case—and this is rarely, perhaps, done—there is no special provision for examining into the causes of accidents on the railways with a view to prevention in future, and no machinery which could be utilized in the personal inspection or testing of new appliances which might aid in lessening these casualties. New railways, before being operated, are required to be inspected, but the inspection is made by some engineer who exercises his own judgment and discretion, there being no well defined rules laid down for his and the railway company's guidance, and no standard up to which every road must be strictly brought before it is opened for traffic. There is no inspection and test of bridges and trestles to ascertain the maximum moving load which can, with safety, be allowed upon them, and no inquiry into the nature and heaviness of the traffic which must pass over them. There are no stated inspections of each road to see if the law is complied with and to give such directions or make such suggestions in regard to the general condition and equipment as would promote the safety and convenience of the public. And the want of these inspections favours cheaply built and inefficiently maintained railways. The machinery of the committee is besides cumbersome and tends to delay inquiries and decisions, through the ministers, whose other duties necessarily require their first attention, being not always accessible. As a matter of fact, the Railway Committee, as a board of reference and control, is not often taken advantage of by the public. Were its scope extended in the direction of the enlarged functions of the Railroad Commissions of the United States, the very composition of the committee would prevent many proper complaints from being brought before it and would thus cause much injustice.

A difficulty—of less importance than it seems—in the way of the appointment of a railway commission whose field of operations would extend over the whole Dominion, is that certain railways have been incorporated by and are subject to the laws of the Provinces within which they wholly lie. The fusion of many of the smaller railway with the larger systems, and the extension of others, is however yearly lessening that difficulty. The last published government report indicates that in 1886 there were 11,523 miles of road being operated within the Dominion, and an analysis of this shows that whilst 1,240 miles might be regarded as subject to provincial control, there were 10,283 miles of railway comprising through and local lines and their leased or purchased branches which can be regarded as, or made, subject to Dominion control, and therefore could be brought within the jurisdiction of a Dominion Railway Commission. The proportion at the present time is probably even more in favour of railways under Dominion control.

It will be argued that the vast extent of the Dominion will preclude the satisfactory working of a commission. In time it might, when the number of miles operated here should approach the enormous mileage of the United States, but when it is known that the mileage in Canada is actually less than the miles of track built in New York State, there need not be a fear that the business for the commission for many years to come will be greater than it can overtake.

Is, however, a railway commission a necessity in Canada? As far back as 1851, when railways were in their merest infancy in the country, Parliament decided that it was, but, as commissioners, appointed ministers of the Crown. The functions of the commission were however limited, and the actual work it accomplished probably even more so. And thus it has been ever since. The Board of Railroad Commissioners afterwards developed into the Railway Committee of the Privy Council, but, whilst after the federation of the provinces, there was a more extended field of operations, and the commission had somewhat wider functions, it does not appear to have commended itself to the general public as—and was perhaps never expected to be—a committee of reference and control. The railway system of the country in recent years has largely developed, and its bearing on the social and material welfare of the people, has increased in an even greater ratio, and yet in its duty to the people, the government has not maintained that actual control over the railways, which governments in the United States have found necessary, nor has Parliament afforded to the public those ready facilities for redress which communities and individuals served by powerful railway corporations should always have. If the

railway corporation has been given enormous privileges and powers by the State, communities and individuals have also rights to which the State should give even greater heed.

The results from the operation of railway commissions in the United States have been most favourable. In some States they have undertaken their work with an energy, a fairness and a thoroughness that have made them powerful agents for good. Apart from the laws which have been enacted on their recommendation, and from the improvements whose introduction has been suggested or enforced by them, the earnest efforts in some of the older States to lessen the causes of accidents form a marked testimony in their favour. There could be no stronger tribute to the value of a well organized commission than the report of the enquiries made in 1886 by the United States Senate committee on Interstate Commerce.

The suggestive duties which a railway commission in Canada should have are:

To consider every application for a railway charter and report to Parliament on the necessity for the same and on the *bona fides* of the applicants and their ability to construct the railway.

To promote the health and comfort of passengers, as in ventilation and other sanitary essentials in cars and station buildings.

To secure safety for passengers and employees by regular inspections, by examining into the causes of accidents, and by investigating and, if necessary, directing the adoption of improvements, which would tend to ensure safety.

To prevent excessive or unreasonably discriminating rates, and to see that railways afford reasonable facilities to the public for traffic as in station buildings, and in the location of such buildings and of the tracks.

To regulate questions between the municipalities and the railways as in matters of taxation and level crossings.

To determine differences between different railways as in railway crossings, interchange of freight and, possibly, competition in rates.

To obtain accurate and full statistics of the construction, equipment and results of operating of each railway.

The first of these considerations is probably unusual, but the great number of railway charters granted by Parliament which never reach beyond the embryonic existence of the statute book, and still other railways, which have been actually built into country already well served by existing lines, make it necessary that some tribunal uninfluenced by party politics or by mere local considerations should be, at least a preliminary, if not a final, referee in the projection of new railways.

The duties of the commissioners should be advisory rather than directory, and its members should depend rather upon the justice of their decisions and upon the influence of public opinion than upon any powers which the legislature might give them to enforce their decisions.

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DISCUSSION.

Mr. Wallis.

If he understood the drift of the Author's remarks, it was to the effect—that the risk to travellers on American Railways was less than in Canada—that this condition of matters had been brought about by the appointment of Boards of Railroad Commissioners in the former country—and that, therefore, the Railway Committee of the Privy Council in Canada should be superseded by a Board of Commissioners similarly constituted.

He desired to speak of the gentlemen forming the various Boards of Commissioners in the United States with respect. They presented to the public valuable statistics which otherwise would be known only to the Railway Companies, and that they made use of their authority, and of the information at their disposal in a wise and useful manner, was obvious from an examination of their various reports. This was especially noticeable in the report of the Commissioners of Massachusetts for the past year, which for detail, excellence of arrangement and illustration was perhaps unequalled. He did not think, however, that the public requirements could be more satisfactorily met, or that anything more was necessary in Canada than the Railway Committee of the Privy Council. The information was obtained in each case from the same source and could be added to or enlarged at discretion.

The author of the paper believed that the statistics of accidents during recent years proved that the risk to railway travellers and employees was greater in Canada than in the leading States of the Union. The meeting was asked to accept as proof of this apparently unfavorable condition of affairs, a statement based on the number of passengers carried, without reference to the length or extent of their journey. The area of Canada was 400 times that of Massachusetts, and its population per square mile less than a two hundredth part. Under such conditions the conclusion was natural, that the average Canadian journey covered a long distance, at any rate much longer than in the smaller State with its dense population. An examination of the Massachusetts Commissioners' report shew that about 15 miles was the State average per trip per passenger. In Canada, the statistics for comparison were not furnished in the Blue Book, nor were they, as far as he was aware, then recorded by Railway Companies. It would, however, be consoling to those whose lot required them to travel in the Dominion, to know that the average of distance in Canada was nearly five times that of the State of Massachusetts, and that the travellers in that State reduced

their risk, not by comparative Canadian insecurity, but, obviously, because their journeys were shorter. The Speaker based his statistics for the Dominion on the working of the Grand Trunk Railway, which for the year 1881 (the last year in which they were compiled) gave an average distance per passenger of 70 miles. The opening of the Canadian Pacific Railway would certainly tend to increase this distance per passenger, so that he did not hesitate to deal with the Grand Trunk figure as considerably below the average of the whole Dominion.

He could not attach any value to a comparison of the records of so short a period as two years, when the figures shewed that they differed so widely from each other as to make it appear by the method of reasoning adopted by the author, that it was three times more dangerous to travel in the state of Connecticut in 1886 than in 1885. He would read a quotation from the 17th Annual Report of the Massachusetts Commissioners:—"It cannot, however, be claimed that our Railways are "thus proved to be safer than those situated elsewhere. Another year "may show a preponderance against them by a single train accident, and "it is only by taking the record of a number of years that fair comparisons can be made." Also, in reference to the returns of killed and injured, which were lumped together without any reference to the proportion of each, the Massachusetts Commissioners, recognizing the unreliability of a comparison under this head had remarked: "There is "no uniform rule as to the degree of injury which should require a "report, and of course the reports do not afford a correct basis for comparison of such accidents on different roads." In his advocacy of a Railway Commission, the author had taken ground which authorities on the subject like the Massachusetts Railroad Commissioners, recognized as untenable, and he would not be surprised, therefore, if such arguments failed to impress those who held opposite views.

There was nothing in the figures submitted to shew that Railway casualties in Canada were as stated more frequent than elsewhere. An analysis of the number of passengers killed for the two years referred to, shewed an average per annum of 7 for Canada and 17 for the State of Massachusetts, and during the year 1887, the number of killed in Massachusetts reached 37, or more than double the average of the two previous ones. These figures could not be called unfavorable to Canada with its passenger mileage of probably but one third less than that of the State of Massachusetts.

The same remarks applied to the number of employées killed, which, for the same period, was 139 for Canada and 91 for Massachusetts, compared with a tonnage mileage in favor of Canada of probably 3 to 1.

The author's method of reasoning seemed a poor argument in favor

of his contention, as could be seen from the figures copied from the Commissioners' report, before referred to, for the past 6 years :—

Year.	Passengers carried (000 omitted).	Passengers killed and injured.	One in (000 omitted).
1882.....	55,868	27	2,069
1883.....	61,531	61	1,008
1884.....	66,517	76	875
1885.....	69,604	74	940
1886.....	75,842	107	709
1887.....	82,923	198	419

It was true that the train mileage per mile of Railway was much greater in Massachusetts, but the danger from such cause was more than compensated by the use of a large proportion of a second main line, of which Massachusetts had some 40 per cent., and which, with the "block" system, was far safer than any condition of working on a single main line as in Canada.

It was somewhat surprising, in view of the number of deaths and injuries from collisions and derailments, that this fact should not have been referred to and dwelt upon as a necessity for the use of double lines of railway and the "block" system of working them; also for the interlocking system of switches and signals, to which reference appears to have been made. Possibly the author had at this stage reached the information that Canadian Railway investments returned per annum but $1\frac{1}{2}$ per cent. as against 5 per cent. in Massachusetts. The shareholders, therefore, could hardly be included among the enriched private individuals mentioned in the early part of the paper.

Managers were not likely to find fault with a system of inspection which would secure the construction of first-class railways, but there would be some difficulty in persuading investors to continue to embark their capital in undertakings which, with the enforcement of a rigid system of inspection, would offer them practically no return. The construction of cheap railways might seem to the author unwise, but it was necessary. If the pioneer railways in the country had been constructed under the rigid rules applicable to densely populated districts, there would have been less mileage, and the progress of the country must have been retarded. The Trunk lines of Canada were however well equipped and of solid construction, and notwithstanding a lighter traffic, were not behind those of the United States in construction, equipment or management.

There was not one of the appliances mentioned by the Author in general use in the United States which was not as general in Canada.

In train signals Canadian railways could claim to be in advance of the majority of those of the United States. If by progression was meant the adoption, of the numerous untried, devices patented by irresponsible inventors, who came in the guise of public philanthropists to cure all the ills that railways were supposed to be afflicted with, Canada was non-progressive. Railway managers were conservative and required the best of reasons for making changes. Real progress had however been made. Power brakes and tight couplings on passenger trains had been in general use for years, their non-application to freight trains was incidental to the necessity for an interchangeable, and therefore uniform, system, and was not in the nature of delay specially attributable to Canada. The call for electric lighting and steam warming of passenger cars had met with an immediate response. The leading railways at once undertook experimental trials of the various systems. It had not required special legislation to suggest the doubling of some of the main arteries when in the public interest it had been found advisable to do so.

As for a proposed inspection of locomotive boilers, the fact that only two injuries had occurred in Canada during the year referred to was sufficient indication that Railway officers were alive to the importance of that subject, and that their system was sufficiently thorough. Could the same results have been achieved in regard to domestic arrangements? and would not an inspection of kitchen ranges and house furnaces, and the appointment of certified attendants have been more to the point?

A Board of Railway commissioners might furnish more statistics but would they give more safety in travel? The author thought so; but while he had for reference the elaborate statistics produced by ideal Boards, an analysis of them rather favored an opposite opinion. The fact, admitted by the author that it was to the interest of Railway Companies to avoid disasters, was in itself a sufficient public safeguard.

Railway commissions in the various States of the Union have not been Mr. M. Butler. thought favourably of by railway managers. It may be taken for granted, that in too many cases, political power has been a more cogent reason for an appointment as a commissioner than railway knowledge. In the majority of the states it will be found that the commission is composed of one or two lawyers and a merchant. Such being the state of affairs, it is not to be supposed that men, who have given their time and best energies to the study of the special questions relating to railway management, should view with favor the meddling of men they deem incompetent give advise in their special line. Is there even one State commission composed of Civil Engineers and railway managers? How then can it be expected under this condition of affairs that the

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It is true that in many states men of great ability and intelligence have been appointed commissioners, and in a number of cases they have called to their aid the assistance of skilled Civil Engineers, as in Massachusetts, New York, Ohio, and doubtless in other States.

Some good has certainly accrued to the public from their existence. The radical defect in the establishment of a railway commission, in the various states of which the writer has knowledge, lies in the fact that it has been apparently overlooked, that the vested interest of the railway is a sacred one, that it is the only source of income to a very great many people, and hence that if a commission has the power to regulate the receipts of a railway, it should also have the power to prevent the altogether unnecessary paralleling of existing lines. In the various States of the Union, it only costs a very small sum of money to secure a Charter. This seems quite wrong, for if the law is to say how much a railway may earn, it should at least protect it in those earnings.

The paper deals so fully with the various causes of accidents that it is unnecessary to discuss it at much length.

Bridges.

There should be a systematic inspection of every bridge—not a mere inspection of a submitted strain sheet—which may or may not agree with the structure it is supposed to represent. This means a great deal of work, and it also means that the Inspector should be free from all control, that his position should be like that of our Supreme Court judges—one of great independence; he should be well paid and hold his appointment for life, unless it could be shown that he was incompetent. His removal to be similar to that applied in the case of the highest judges. On the Atchison, Topeka and Santa Fe Railway we have power brakes on all freight trains, the result being that every fast time is made with greater safety. The Westinghouse Automatic brake is used exclusively. On such a road as the Colorado Midland, where a four per cent grade and 16 curves are in use, it would be impossible to operate it without power brakes. The Denver and Rio Grande Railway also uses the Westinghouse Automatic brake, as these roads including the Burlington route probably interchange as many cars as any other on this continent, the argument that because *all* railways do not adopt them *none* should, does not apply with much force.

Couplers.

The recent action of the Western Mechanics Association, in recommending the Janney type of coupler, will no doubt soon bring about the adoption of a better mode than the old barbarous pin and link.

Steam heating.

The speaker would draw the attention of the members to a report of the William's system of low pressure steam heating direct from the engine, contained in the *Railway Gazette* of 24th February, 1888.

Walking on the Track.

There is already a law on this point in the Statutes of Canada, but hitherto it has not been enforced.

Bridge Guard Rails.

The Latimer Child's device is so well known and so thoroughly efficient, that, such railways as are too penurious to adopt it, should be compelled to do so by law. A great many other devices are in use, but none of them can show such a record. Mr. Butler knows of only one bridge in Canada protected by this guard.

Mr. D. MacPherson remarked that Mr. Wallis' able and exhaustive statement of the facts under discussion left very little, if anything, necessary to prove that Canadian Railways were not behind the times as regards safety and convenience for the public.

The author of the paper before us draws rather an alarming picture of the conditions and risks incident to railway travel in the world generally, and in Canada in particular, but seems to have brought forward no very definite practical remedies. On behalf of the railways he may be permitted to say, speaking as a Resident Engineer of a leading Canadian Railway, that there is very often great risk attendant upon the adoption of so-called improvements in guard rails, switches, &c., &c., until they have been shewn to be real improvements. The best safety appliances, which no amount of patent combinations will supersede, are competent and reliable employees.

The safest road to travel upon is the one which has the most experienced management combined with the most skilful, careful and reliable subordinates of all grades. Such a management *will not accept* the ideas of every "crank" who has or wishes to get a patent on an entirely unpractical device, but *will adopt* improvements which can be practically shewn to be such.

Again, we have a mass of figures given in this paper which are intended to shew the number of passengers killed in proportion to the total number of passengers carried, in certain parts of the United States, and also the same figures for Canada during corresponding years. Now it appears to the speaker that these figures prove nothing at all. It is perfectly absurd to say that the risk of travel is in direct or anything like direct proportion to the number of passengers carried. If the author will carry his researches further and say, in addition, the average number of miles travelled by each passenger, he may then deduce something like a ratio of the risks of travel-

At present, from the facts given by older and more experienced men here to-night, railway men in Canada have every right to assume, and the public every right to rest assured, that travelling in this country is no more risky and perhaps very much less so, than is the case across the border.

Mr. Cunningham Mr. Drummond's paper on Railway Accidents brings forward a very important subject. It is undoubtedly the case that many preventable accidents occur, and though travelling by rail is safer than any other mode of locomotion, still there is room for improvement where such accidents take place. By preventable accidents are meant those which, by the exercise of proper care, and the employment of the accumulated experience bearing on the subject, in the construction, maintenance and working of railways, would not have occurred. Accidents which are caused by defective track, defective bridges or trestles, inefficient fences, low bridges, buildings too close, &c., &c., are in by far the greater number of instances preventable accidents. And yet many railway corporations prefer to run the risk of accident, and pay the damages when they arise, rather than be at expense of removing the apparent cause. There are railways that could easily be named (running through long settled country) where there are no fences to speak of, and where the management prefers to pay for cattle killed or passengers injured rather than fence the track, and laughs at legislative enactments that no one ever undertakes to enforce. There are railways, where the low overhead bridge counts more than one or two victims, and yet continues to exist; and there are numerous examples to be found, of weak, rotten and unguarded trestles, patiently waiting the time when they will spring into notoriety as the cause of a "frightful accident."* Such things demand the attention of those who aim at making railway travelling more secure.

To the civil engineer the part of the subject that lies most within his province is that which deals with the construction and maintenance of the roadbed, track, bridges, trestles and buildings, rather than that which deals with locomotives and cars, or the running or management of trains, and it is to this that the present correspondence is confined.

In order to have a track in perfect condition there is no one thing that is more essential than thorough drainage. A perfect roadbed is one on which no water stands and no moisture collects in the ballast. Drainage is essential in every country, so as immediately to carry off heavy rain falls, and prevent "washouts," or settlement from soakage; but it is doubly necessary in such a climate as the Canadian, where we are sub-

* At the very time of writing comes the news of the terrible accident at Blackbear, near Savannah, caused by the train first being thrown from the track by a broken rail, and then striking and knocking down a trestle.

ject to sudden thaws, followed by severe frosts, when, if the water has not been drained off, the track is "heaved" by ice forming, and thrown badly out of surface. The consequences of this "heaving" are that the train may be derailed, particularly if the heave is on the inner side of a curve, or a rail may be broken by an undue strain being thrown on a particular spot, where the rail is acting as a girder, holding up the ties instead of being supported by them. In order temporarily to remedy these defects, the section men have recourse to "shimming up" the track by packing blocks of wood of the necessary thickness between the rail and the ties. But the frost comes and the evil is done all at once, whereas it takes the section men days to get over the section and take out the worst spots; and in the meantime the traffic rattles along over the track, "always on time," while the cars oscillate and swing with that sickening motion so familiar to passengers. When the spring thaw comes, the evil is just reversed; the frozen humps thaw out and settle down, leaving the high spots where the track has been "shimmed."

Few people, who have not paid special attention to the subject, have any idea how much particular kinds of soil heave with the frost. The writer has seen a point in Prince Edward Island, where it was necessary to "shim up" the rail 11 inches, in order to take out inequalities caused by the frost. The Island soil is unusually troublesome in this respect, and this was on a part of the Island Railway where there was, practically speaking, no ballast.

To radically cure such defect perfect drainage and plenty of clear, dry ballast are necessary. Without these there never can be a track safe for fast running. A strong rail, with rigid connections, is of great value in giving a uniformly smooth surface, and has much effect in reducing the heaving by frost. In an instance that came under the writer's personal observation, a weak iron rail was taken up and the track relaid with a strong steel rail. The immediate effect of this was to reduce the heaving by the frost in a most surprising degree. A little observation shewed the reason. Under the locomotive the iron rail yielded to a considerable extent, causing a "pumping" action of each tie; this sucked up moisture, which was frozen, and the track heaved; but with the stiffer steel rail, the "pumping" action was much reduced, there was less moisture drawn up, and consequently less heaving. For similar reasons a rigid connection of the rails should be sought for, and the angle plate joint is a great improvement over the fish plate. With a weak connection in spongy ballast, it will always be noticed that the track heaves at the joints.

Constant attention should be given to maintain the proper elevation of the rail on curves. The elevation should be set to suit the speed of the

fastest trains. But even on old established and well appointed roads the straining and jerking of the cars, as they round sharp curves at a high speed, often shew that even this most elementary precaution is not attended to.

It hardly needs pointing out that the ties should be immediately renewed whenever they shew rot or cutting from the flange of the rail, and yet the fact that they are not always so renewed may be sufficient reason for directing attention to it here.

In the writer's opinion, the steps that should be taken to maintain a track in safe condition should follow the lines above indicated, rather than those tending to supply guards in the event of a train leaving the track. Mr. Drummond's proposal to lay down guard timbers on high embankments is open to grave objection. The timbers to be of any service would have to be at least 8 or 9 inches square, and in order that the snow plough (a most indispensable agent in Canada) running in winter should clear these, they should be at least 6 feet clear of the centre of the track. This would necessitate a much wider bank and longer ties than at present in vogue; and this again would render more difficult that perfect tamping and packing of the ballast on which the life of a track depends. Laying double rails inside the main rails on embankments is also objectionable, as allowing the track to become clogged with hard packed snow and ice. It is of great importance in winter that the track should be as clear as possible of fixtures between the rails, so that the "flanging car" may be run freely over it.

Heavy guard timbers, with wide floor timbers placed close together, should be on all trestles, as Mr. Drummond suggests; also the inner rails, brought to a V at either end of the trestle. The writer has known of a serious accident having been prevented by this precaution.

In many instances where wooden trestles are erected, it would be more consonant with good engineering that stone arch culverts should be built and the hollow filled in with earth. Of course this is objected to on the score of expense, and for cheap lines, intending to do business at moderate rates of speed, the objection may be allowed; but on a first class road that proposes to run trains on a schedule time of 55 miles per hour or so, such objection should be overruled.

The writer is well aware that the recommendations in regard to maintenance of track, set forth above, embody nothing that is new to the engineering profession. Yet it often seems that sufficient importance is not attached to the carrying out of such rules by railroad managers, and those who directly control the expenditure on railways. The money expended on absurdly gorgeous parlour, dining, or sleeping cars would usually be of much more benefit to the property and the public,

if laid out in ballast, ties, and sectionmen's wages. But the first mentioned expenditure is always the more pleasing to the management on account of the display it makes on the road; while the second is unseen by the travelling public, though it may always be distinctly felt.

That the line should be properly and securely fenced, that bridges should be strong enough, that they should not be too low, that buildings should not be too close to the track, all these go without saying. And yet an examination of some roads would disclose the fact that even in these matters there is much room for improvement, and need for pressure being brought to bear to enforce agreement with sound precepts.

This suggests the propriety of some form of railway commission for the purpose of overseeing in the interests of the public the various matters connected with the construction, maintenance and working of railways. It certainly seems strange that in this country, where railways have been built largely by Government and Municipal aid—by money supplied by the general public—there should be no public functionary or officer whose duty it should be to see that the line is maintained and worked with a proper regard to safety, and that the various legislative enactments are complied with. In England such work is performed by Inspectors appointed by the Board of Trade, and the "Railway Inspector's Office" forms part of that department of Government. It is also the duty of these Inspectors to hold enquiries into the cause of accidents when they occur, and their reports are of great weight in fixing the blame upon or exonerating the Railway Company. In this country officers appointed by the Dominion Government would labour under the disadvantage that the Government itself is also a Railroad Corporation, and one not guiltless of the sins of omission and commission above alluded to. Some form of periodical inspection of Railways, together with an organized system of official enquiry into the causes of railway accidents, by competent and unbiassed men, would be of much service to the Canadian public, and would have a marked influence in reducing those defects in construction and management which produce accidents. As a means towards obtaining this, the appointment of a Railway Commission to enquire into the subject would, in the writer's opinion, be a move in the right direction.

Mr. Barnett remarked that if the author's statements and reasoning Mr. Barnett. are to be accepted the logical conclusion is that the State should purchase at great expense, improve and then work all railways.

If, however, a commission must be appointed to control private property, its province and its power to compel a Railway Company to spend money should at first be restricted to new construction until such time as its decisions have been successfully tried and the commissioners themselves have gained experience.

The paper covers wide ground, and he could only touch upon a few of the points mentioned by the author.

One is the safety of mineral oil of 300° flash test. There have been numerous tests of this oil. Flaming cotton waste and hot cinders dropped into it have been extinguished, and hot cinders put on to a board saturated with it only charred a small surface slightly larger than the cinder. There is no record of any American railway casualty in which lamps burning this quality of oil caused any injury to passengers.

Steam heating is still in the experimental stage on all the railways mentioned by the author, except the suburban service in New York and its neighborhood, where the Gould storage system is used. These coaches every 2 or 3 hours are connected with a stationary high pressure boiler, steam from which warms up brine in a 5" or 6" tube running the length of the car. This acts as a storage reservoir, and is fairly effective; but there is no case of storage system and *low* pressure steam in through pipe from locomotive being worked satisfactorily together. Where the storage system is used, the passengers are not present when high pressure (high temperature) steam is passed through pipes and couplings.

No Railway officer would, last fall (with the limited experience then possessed), have been justified in recommending the expenditure and changes necessary to equip all the passenger stock of a through Railway with any patented system of steam heating, their known defects and possible failures being too serious. The particular patent recommended has but one point to distinguish it, viz., the coupling between car pipe and car pipe, the use of reduced pressure steam being common to most of the systems.

One fine morning this winter, the speaker examined a waiting branch train equipped by the patentee, and water was passing from every point. Judging by the volume of this water, more steam was being used to keep a short, unused train comfortable, than inventors generally claim is required to do the whole work with train in motion when temperature is low. A through fast train passed through this same depot, using another style of coupling, and so much water had leaked out that it was a matter of surprise that the automatic brake gear was workable.

A Railway committee is at present endeavoring to secure a flexible pipe coupling that shall not only do its work effectively, but also permit the free interchange of coaches.

In the matter of automatic car couplers he said he knew of no single thing that had done so much to check progress in their general adoption, than the action of the various bodies of Railway Commissioners.

They had in various States enforced the use of different types that

were far from coupling automatically with each other, and the result was that the men had to go between the cars to make the coupling when two odd kinds of automatic couplers came together, with risk to life and limb, increased beyond what followed the often careless coupling with the link pin and old-fashioned bullhead drawbar. Railway men have now taken heart again in this matter, and the Master Car Builders (not the Master Mechanics) Association is actively engaged in settling the lines of a hook coupling, which shall be automatic and yet have a wide limit of application.

The author has large faith in Government boiler inspection; but the example he quotes scarcely justifies this faith, as the only boiler casualties in Canada mentioned in the two years taken for comparison, are boilers under the control and inspection of the Government.

It is not proven that the railings at the sides of the roof plank walk, even if all cars were so equipped, would be any additional protection for brakemen. Certainly while in course of change, the risk would be increased, and the same could be said of the oft-repeated recommendation for an increase in the width of walk. Inequality of present equipment may have its risks, but it is not wise to increase their number. This matter of railings and increased width of walk is very fully investigated and discussed by the Ontario Legislature's special committee on Railway accidents. See its report in 1880.

In the matter of additional means to prevent the upper berths of sleeping cars, is it on record that the wires attached to such berths ever failed to keep the berth in position?

The author properly recommends the testing of passenger train wheels every 60 miles (a daily practice for all cases of trains in Canada); but does not say anything about increasing the safety of the wheel itself. One railway where travel is alleged to be so dangerous (the Grand Trunk Railway of Canada) uses for its passenger truck an expensive but practically indestructible wrought iron wheel, fitted with steel tyre and circular clips, so that in any case of failure, neither the type nor any short segment of it can be lost.

Hence, in this matter, our practice is in fact far beyond that of our neighbors, with whom we are compared, and (it is believed) far beyond the action of any American Board of Commissioners.

Statistics such as those referred to in the paper and by other speakers ^{Mr. T. Brown.} are so capable of distortion, either intentionally or unintentionally, that deductions therefrom should be drawn only with the greatest care; and when the mileage run and the number of travelers and employees are considered, the wonder is that the casualty list is not larger, and the speaker for one, gladly gives railway men the

credit due to them. At the same time, there is no reason why every possible means should not be taken to reduce the risks of travelling and railway working to a minimum. He would therefore approve of Mr. Drummond's suggestion of "regular inspections," made in connection with or by order of a Railway commission.

It is noticeable that our railway friends have the idea that any commission connected with the government would be a farce, and the members fools. But there is no necessity that it should be so. A commission of practical utility exists in the old country, and there are very good indications of the benefits of commissions in the United States. It is not natural to expect that railway men should favour a commission any more than they are likely to suggest a reduction of their salaries; but we are human and fallible, and no matter how high-minded, conscientious or solicitous of the public safety a manager may be, we are all the better for being looked after. The government inspection of steamshipping is indisputably wise, and there can be no one present who is prepared to deny that a great number of lives have been saved by the Board of Trade regulations. Why should railroads be differently treated from steamships? What is practical and beneficial in the one case would be in the other. It may be freely admitted that to a manager, it is a nuisance to be liable to have to put your ship in dry dock when she is worth ten dollars an hour, to have your boilers strained, your steam pressure reduced, hose pipes and life belts condemned, &c., &c.; but the effect is to promote increased carefulness, better construction, and the use of a higher class of property, while the compensation is in the increased confidence and patronage of the travelling community. Those individuals or companies, which receive pay from the public in exchange for travelling accommodation, ought to offer the best assurance of safety possible. In the case of railways or subsidized steamship lines, the public through the government of the day grant valuable rights and privileges, which give them (the public) the right to see that the maximum of safety is insured.

A Railway commission competently formed and adequately empowered appears to be desirable, and the speaker does not hesitate to say that no manager of any transportation company fit for the position would fear the commission or its inspectors.

Mr. Dawson.

The method of applying the brakes on freight trains is at present attracting attention, with the endeavour to devise a system which will make it unnecessary for the brakemen to pass along the roof of the cars to apply the brakes. If this practice could be abolished, it would have an important bearing on the prevention of accidents; not only directly, but also in rendering the construction of overhead crossings practicable in a much larger proportion of instances. In this country, the

legal headway required in the case of overhead crossings is twenty-one feet clear from the top of the rail, which is enacted for the safety of the brakemen when on the roof of the cars. In France, where this is rendered unnecessary by applying the brakes in another way, the legal headway is only 15 feet 9 inches, which has the further advantage of reducing the cost of overhead crossings in a marked degree. In a level district, undergrade crossings or sub-ways are impracticable, as it would often be impossible to drain them or to prevent them filling with snow; and for overhead crossings this difference in headway would reduce the cost to about one-half. In travelling in a flat country like Yorkshire, it is impressive to a Canadian engineer to see every road carried overhead across the track. Without going into the question of how the brakes might best be applied, it is important to note the indirect bearing of the change on the prevention of accidents arising from the prevalence of level crossings.

The prevention of Railway accidents has engaged the attention of the public for many years. At first sight, since nearly all these accidents are preventable, it seems a simple matter to make them so, but on investigation we find this by no means to be the case. Take for instance innumerable patents for railway couplings, all of them good but for some fatal objection. What man of a mechanical turn has not invented, or at least designed, a coupling? The speaker has designed two. Early in life he invested \$100 in a perfectly infallible one, which, however, was never heard of. The inventor told him that each railway manager promised to adopt it if he could get all the rest to do the same, a very safe offer as it proved. In fact, the first essential preliminary to an universal coupler is a continental law, fixing one exact height from the level of the rail to the centre of the draw bar. Mr. Henshaw.

Leaving this, the most fruitful source of accidents, for the present, we find that other sources of accident are equally difficult of practical solution.

The New York commissioners, as Mr. Drummond informs us, recommend a low railing on the top of the cars along the centre, and an extension of the running board beyond the ends of the cars, and a similar plan is understood to be recommended to the Canadian Government. Now, according to the speaker's experience, it seems very doubtful that these recommendations have originated with the parties most concerned. They seem suggested for the benefit of old or timid men, who are precisely those not employed. Brakemen are always young and active men, and accidents from slipping off the top of the car are almost unknown. The running boards are flat, while the top of the car is round. Therefore, as the first impulse of a man when slipping is to squat down

and grasp the edge of the running board, there is no need of a railing which is otherwise a nuisance to his freedom in balance, and in handling the signal cord. Falling between the cars is a more frequent accident, and sometimes occurs in passing from car to car, but more often by a jerk received when braking. It is to be noticed that these accidents are more frequent with the older hands than with beginners.

To project the ends of the running boards beyond the ends of the cars seems to the speaker not only useless, but dangerous in the extreme. The cars of a freight train are rarely of uniform height. In leaping or stepping, the foot always lands on the edge to prevent its slipping forward. The accident occurs from a side jar, and the man has a better chance to save himself on the edge of the car than half way between. As perfect a remedy as is possible for this as well as that from the jerk of the brake, would be to put the ladders always (as is mostly the case now) on the left side of each car gable, and to connect them with an iron rod running the whole length of the gable, level with the roof and below the level of the running board. This would give something to the falling man to hold on to, and make his way thereby to the ladder.

About one-third of the total loss of life or injury by railway accidents is due to the coupling of cars, and almost all of these on freight trains. Taking all things into consideration, there does not appear much probability that the old link coupling will be superseded, nor on the whole does the speaker believe that a much better contrivance will be found for simplicity and effectiveness. Accidents here are caused by lifting the link with the hand, by which the hands or fingers are crushed. Freight trains cannot be backed with the steadiness of passenger trains, and hence a sudden dash of the cars catches the hand before it has time to withdraw. For the same reason, the man is often struck and his foot slipping, he is thrown down and injured, or killed before he can escape.

An old brakeman told the speaker that he had coupled cars daily for twenty years and never had an accident, though he had had dangerous bumps while between cars. He said he never lifted the link with his hand but always with the pin, and the instant the link entered the jaw he put the pin in its place. Now if a long iron stirrup or step, reaching down to a few inches of the ground, was fastened to the end of the car near the draw-bar, with an iron handle, placed at a convenient height above to be grasped by the left hand while the foot rested in the stirrup, the coupler could easily and safely use the right hand with the pin in it to lift the link and afterwards insert the pin; while being on the car itself he would not be in danger of hurt from a sudden jolt.

Mr. Drummond does not refer to a recent invention for preventing

car trucks from turning at a dangerous angle in cases of derailment. The plan, though new, has been severely and successfully tested by an accident to a Canada Atlantic passenger train, which, in consequence of a bush fire that consumed the track sleepers, was derailed and almost entirely consumed without a single car having been damaged by telescoping or collision; and thus not a single passenger was injured. This is a very remarkable case, and well worthy of careful consideration. One more point is to be noticed: namely, the tools that the law requires to be carried in Passenger cars. These are generally placed in receptacles that can be opened; and now-a-days, for that reason, the places are to be commonly seen but not the tools. The best mode is to place them in a cage, formed of light wooden slats, which must be broken before they can be got at.

In selecting "Railway Accidents and a Railway Commission" as Mr. Macklin. a subject for a Paper, Mr. Drummond has opened a somewhat comprehensive question to friendly criticism, that can only be lightly touched upon within the limits prescribed for the discussion of a scientific paper.

It has first to be shewn, that the proper and most effective means of exercising control over Railways, whether in regard to accidents, or generally in respect to all matters in which the public interest in Railway is concerned, can be best brought about by creating a so called Railway Commission.

Experience of the working of Railway Commissions, whether in England, the United States or Canada, has not proved its adoption to be the one and only successful way of dealing with the question.

The subject, in this country, has long exercised some of our legislators in the Provincial as well as the Dominion Parliaments; but we often find that the most active supporters of State interference with Railways, and of positive measures of Railway legislation, come from among those who know least about the difficulties surrounding the subject. These gentlemen, if they could, would prescribe the management and policy of the Railways of the country, regardless of the fact that though public highways, they are also private property.

It was probably to guard against, and put a stop to impractical legislation, and to satisfy hobby riders on Railway reform, that the Dominion Government deemed a full enquiry by Royal Commission the most business-like way of getting the facts concerning so important a matter. Hence it is, that to the Report of the late Royal Commission we must look for the only opinion of real value, so far as Canada is concerned, that has yet been given on the subject of a Railway Commission.

It is true its investigations were confined chiefly to enquiries res-

pecting tariffs, discriminating rates, and so forth; but the object for which the commission was established was to shew if the necessity existed for creating a permanent commission that should be empowered to deal with all matters of Public Policy relating to Railways.

The report is unfavorable to the founding of such a tribunal. Its recommendations lie chiefly in the direction of giving more extended powers to the existing Railway Committee of the Privy Council, a conclusion which, it may be safely stated, will be generally accepted as wise and practical, as being the proper means of regulating our commerce, of protecting and conserving public interests in all matters concerning Railways, and of solving a problem, fraught with many concealed difficulties, without friction to the companies and with least injury to the important private interests entrusted to the management of Railways.

Mr. Drummond refers to the fact that Permanent Railway Commissions have been established in twenty-one States of the Union. We may congratulate ourselves that we are not similarly afflicted.

In the first Report of the Interstate Commerce Commission, it estimates that no less than twelve hundred Railways, operated by five hundred corporations, are subject to the Provisions of the Act.

Is it not, therefore, a striking commentary, that whereas, twenty-one Permanent State Railway Commissions out of a possible thirty-eight have been created to control a portion only of the enormous Railway System of the Union, the Federal Government, under the Interstate Commerce Act, is satisfied to place in the hands of four men the entire responsibility of dealing with the most perplexing problems relating to the Regulation of the vast business of the whole of the 138,000 miles of Railways in the United States?

Judging from this, therefore, it seems that we can, at present, at all events, without unduly burdening our Ministers, place in their hands the duty of dictating the public policy that shall control our 11,000 miles of railway.

We should not look altogether for guidance, or place too much reliance on the experience of State Commissions. They are often affected by State Politics. According to the judgment of the Supreme Court of the United States, the Legislatures of the several States have complete control in all respects of the Railways within the limits of the State. As a consequence of this power, legislation is introduced to meet every supposed grievance, and laws are enacted that do a manifest injury to railway property, and an injustice to those who have invested their means in them. As instance the fact, that there are now before the State Legislature of Iowa, a State possessing a Railway Com-

mission, no less than seventy-five Bills introduced since January, each providing some sort of regulation of railways. The statement is made in regard to it, that if the proposed legislation becomes law, as it probably will, politics being at the bottom of it, the value of the railway property of the State will be decreased at least one-half, or \$175,000,000.

Such a condition of affairs might have its parallel in Canada, if our Provincial Legislatures controlled each in their own way the large Railway interests of the country.

What, among the list of suggestive duties of a Railway Commission laid down by the author of the paper under discussion, could not be equally well treated in the public interest by our Railway Committee?

With the Consolidated Railway Statutes before it to guide its deliberations, and proper departmental officers to advise it, there is no reason why the public interests should suffer. The history of this tribunal in the past has been eminently satisfactory to the public and to the Railway Companies.

With Mr. Drummond's statistics it is not my purpose to deal. They are very unfavorable to Canada, and would reflect seriously on the management of our Railways and on our laws, were it not for Mr. Drummond's subsequent remark that they are "*without any exact value.*"

We shall all be pleased to feel that it is so, that we need place no reliance on them. But what are we to think of the publication of such disquieting statements? Why, if fallacious, make use of them at all?

Statistics, to be of value as an instrument of reference, must be expressed in figures of undeniable accuracy; and the most conscientious enquirer will fall into difficulties in preparing comparative statistics, if in order to support his argument he resorts to figures that can only be comparable when based on equal conditions.

Turning briefly to consider Mr. Drummond's recommendations for the greater safety of the travelling public:—

GUARD RAILS ON BRIDGES AND EMBANKMENTS.

There is a wide difference of opinion as to the value of Guard Rails on Bridges. Personal experience leads one to doubt their efficacy, and to conclude that the advantages claimed for them are of questionable utility in time of emergency, as in the event of sudden derailment of a train at high speed, except, perhaps, under certain circumstances.

The exceptions are where bridges are approached by curves or built on curves of greater curvature than, say, 4° . In such cases a check-

rail should be placed next to and inside the lower rail to counteract the centrifugal tendency of trains at high speed, to leave the track on a tangent.

The speaker knows of no practical system that can be shown to be a real safeguard in the event of derailment, not even the complicated and expensive Latimer Guard referred to by Mr. Drummond. Our guards are necessarily set too low, to clear the Snow Plough, to have much effect in turning the direction of a derailed train. Why bridges should be selected for special protection, has always appeared to him to be an anomaly. As a general thing the track on bridges, being unaffected by frost or weather, is usually in better alignment and surface than other parts of the line. It is also suggested that *guards* be placed on embankments. What embankments? What is the least height of embankment to be so provided? Where are we to draw the line? The result of a "run off" on a five feet bank is as likely to be as disastrous to those concerned as if it had happened on a ten feet bank; so that, to be consistent, we must place the "guards" on five feet banks as well, and why not then *ad infinitum*.

All Engineers will agree with Mr. Drummond that the decks of bridges should be laid close, by which is meant that the ties should be spaced not more than 4 inches apart, and be strong enough to carry a derailed locomotive. Moreover, all bridges should be designed to meet, with a wide margin of safety in their favor, any strains that may be legitimately put upon them, whether due to frequent traffic, heavy rolling stock, or high speed.

All these important points, however, will be wisely considered and looked to on any important line where responsible and efficient officers are employed, with special duties to perform, and reputations to uphold.

Other safeguards and suggestions for the safety of public travel and railway employes, referred to by Mr. Drummond, are steps more or less in the right direction.

Railway officials are fully alive to the question of safety, and realize only too forcibly, by the most telling evidence, the immense responsibility placed upon them by the public; and they will be found ready to adopt, without the goading influence of Railway Commissioners, any safeguard of unquestioned value that will commend itself to their practical judgment and experience, as being likely to prevent loss of life and property.

The speaker would pronounce against the establishment of a Railway Commission, or any tribunal other than the Railway Committee of the Privy Council, because in that body with its Book of Statutes, compiled by Parliament as experience dictates and the country needs, with means of extending its powers indefinitely in any direction that Public Policy

may require, with a properly constituted staff of Departmental officers as an advisory Board, and its actions for good or evil, subject to the full criticism of the Parliament of the country, the wants of the public in the direction of Railway regulation will be amply provided for.

An examination of the statistics set forth in this paper shew the truth of the saying—that figures may be made to prove anything— if it is sought to shew that travelling in Canada is more hazardous than in the United States. Mr. Harkom.

The remarks referring to the table compiled from U. S. statistics rob it, however, of any value it might otherwise have had, for they shew it to be impossible to calculate any percentage of casualties for purposes of comparison with Canadian statistics. The speaker has not had the opportunity of examining them very closely, and has left them to those gentlemen who are more competent than himself to deal with them. He will confine his remarks to the more or less practical suggestions offered as likely to render railway accidents less frequent, and which it would be the part of the duty of a Railway commission to see put into practice.

They being under separate headings, he will discuss them in the order in which they occur in this paper.

GUARD RAILS.—The proposal to put guard rails on all embankments exceeding a certain height naturally suggests the question, "What height?"

As on all Railways within the region affected by snow fall, it is desirable to build the road-bed at least three feet above the level of the surrounding country, and there being also a ditch beside it, we may reasonably expect to see a bank five feet high, down which a very respectable tumble would result to any train leaving the track.

This being the case we might as well put guard rails all along the road bed, and to carry the suggestion out, might make a trough, put the rails in the shape of runners on the cars with wheels in bottom of trough, when we might reasonably expect never to get off the track. One thing is particularly noticeable in this connection, and that is, that it is assumed that the running gear is always in good order after the derailment, the latter being, so far as this paper is concerned, a mysterious dispensation of Providence, and something not considered. The fact is, however, that in only too many cases we hear of broken wheels, caused by the tremendously heavy strains to which they are subjected in this North American climate, as being the cause of derailment, and no guard rail will keep a broken wheel in its place after it has once struck the top of the guard rail.

The proposal to put heavy additional guard rails near the trusses of bridges is a peculiar one, as the consideration of the position of the body of car when the wheels reach that point will shew.

The question whether the floor system is able to carry a derailed train is of no importance, as when a train gets into that position, a few more precautions such as recommended do not amount to much, for if the speed of train is reasonably great the cars will pile up. It is also altogether overlooked what the result of a derailment in a cutting would be, where cars pile up far worse than on a bank on which there is room for them to spread. It is apparently inferred in this paper that guard rails and a stronger floor system would have modified if not prevented the Dedham disaster, whereas if the cause, as generally given, was the true one they could have had no effect on it whatever.

BRIDGE INSPECTION.—In this connection the inference is made that Canadian roads get an insufficient amount of inspection, which the speaker challenges as an unsupported charge. Such inspection is not only considered necessary, but carefully carried out on any road that carries passengers or freight, with a view to profit, the result of a failure being only too likely to affect the earnings to a very considerable extent. The remarks concerning the New York Commissioners are a little confusing, as the distinction between design, construction and maintenance is lost sight of, and, on behalf of a most intelligent and trustworthy class of men, the bridge foremen, it may be declared that the New York Commissioners did not desire to throw discredit upon them if on any one.

The Dedham bridge is again here brought in under a different aspect, and another slur, on what may be called the very backbone of mechanical production, viz., "machinery," is given.

It is by no means shewn by this paper or by anything the speaker has heard on this subject, that any theoretical examination would have detected what was actually a mechanical failure, and we may reasonably dismiss the subject in this connection, by saying that this particular machinist did not do his duty thoroughly.

OVERHEAD BRIDGES.—It is not at all to be considered as a direct consequence upon the adoption of power brakes on freight cars, that it will be unnecessary for the brakemen to be on top of the cars, as, especially on long grades, they have to go over them to relieve brakes in order to prevent overheating by continual application, it being unsafe on many grades for the brakes to be released on all the cars at the same time.

The correct principle would seem to be to regulate the height of the cars as well as that of the bridges.

In Canada, however, we are on this point a long way in advance of the U. S. in our railway legislation our head limit being more.

FREIGHT CAR POWER-BRAKES.—So much has been said on this

point that it calls for little notice in these remarks beyond the statement, made as the result of experience as a Railway official actively connected with the working of a large district, that the cases of men falling from cars are largely overestimated.

RAILINGS.—Such protection, as suggested here, and as was brought up in the Ontario Legislature some years ago, is simply impracticable and really more likely to cause than to prevent the evil (so largely exaggerated) complained of. The best safeguards for a man in the position of a brakeman on freight cars are a clear head, quick sight and a firm foot, and any one not possessing these has no business there.

COUPLERS.—The amazing statement that nearly one-third of the casualties to "*passengers, employées, and others,*" arise from coupling cars leads one to suppose that the author of this paper must have been misled by the statistics he has consulted.

The very fact of the use of automatic couplers on passenger cars for so many years, and the fact that the speaker never remembers hearing of injury or death resulting to *passengers and others* from this cause, helps to cast a doubt upon the reliability of statistics quoted elsewhere.

The statement as to increase in Massachusetts also seems to call for more light before a conclusion can be arrived at, and it may be stated that in the case of a man coupling cars, and apart from falling or stumbling, etc., there is no necessity for him to get crushed between draw-bars, as no man need put his fingers to do what a piece of stick will do equally well, and which would cost less for sticking plaster if squeezed.

The enumeration of a number of well advertised freight car couplers, out of the large number which are to be found in the Patent Office, at Washington, is by no means a proof that they do their work satisfactorily; and the fact that the Master Car Builders are even now trying to reconcile the different principles or designs, shews them to be unsuitable for the purpose intended, and they are really only attempts to do by other means what is so ably done by the Miller Hook and Buffer in use on passenger cars.

PASSENGER CAR TOOLS.—A very good thing and very practically set forth in the paper.

TESTING OF WHEELS.—This is imperative, and is actually done more carefully and oftener in Canada than on American roads generally.

ELECTRIC LIGHT.—Whenever practically perfected this will without doubt come into use without legislative action; meanwhile, the using of the mineral sperm oil of 300° fire test is the best thing that can be done, and cases where damage is said to have followed its use have never been properly verified.

STEAM HEATING.—This matter is still in its infancy, and until

the experiments have been properly made, the Baker heater is really the very best thing in use. The speaker has himself seen them very completely inverted by derailment of car and no escape of fire or damage result therefrom.

This system also can be combined with a supply of steam from the locomotive, and that will be the most satisfactory and practical solution of the demand made by the public since the deplorable loss of life by overturned stoves in passenger cars has been so frequently brought before it.

A satisfactory combination such as this, is the one to be desired in view of the difficulty noticed in this paper, of cars being side-tracked at local stations.

PULLMAN BERTHS.—The inference made concerning the appliances used to secure berths from being closed while in use is not a just one, as no specified cases are known where the fastenings referred to failed; but under any circumstances, the hanging of a coat or other garment on the hooks above will effectually prevent the berth being closed and locked, no matter how it may be placed.

PASSENGER ACCOMMODATION.—So long as passengers are allowed to pay fare on the cars, so long will there be no remedy against sudden overcrowding.

LOCOMOTIVES.—Under this head the author makes an imputation of neglect which a practical acquaintance with the construction and maintenance of loco-boilers would have saved him from.

SAFETY VALVES.—He makes a suggestion which bears on the face of it strong recommendations, but if such a safety valve as he describes were adopted, the incrustation, which is so well understood to form about all such openings as are referred to, would in a few days render it inoperative. The reduction of the number of openings in a boiler is the best cure or prevention of the danger indicated.

It is a little unfortunate that the author was not a little more clear in the description, as at first sight it is very like a recommendation to hermetically seal boilers which safety valves, as generally used, are carefully arranged not to do.

Another case of difficulty in understanding statistics as set forth, occurs under this head, where it is stated that within a year and a half one hundred and sixty-two persons were killed or seriously injured, by scalding, in six accidents.

Now this makes an average of twenty-seven, and the speaker has no hesitation in saying that there must be a mistake somewhere, as it is to scalding by locomotives that this extraordinarily large number is said to have been due.

TRACKS.—The suggestion as to blocking frogs is good, but again this is not unknown in Canada.

It is perhaps an oversight that among all the suggestions for inspection made in this paper, no mention is made of the inspection of tracks, which, however, is always carried out, and much confidence is felt in consequence of the knowledge that such regularly and daily takes place.

The reference to level crossings of railways affords another instance of imputation of neglect, whereas the Dominion Railway Act is more particular in its requirements than those referred to, as a full stop is always required.

EMPLOYEES.—The question of intemperance is not alone within control of the employée, but is actively and energetically dealt with by Railway managers and officials, as experience would shew the author if he were acquainted with any employée who developed such habits.

The question of rest is not the one it is represented to be, the trouble railway officials have being rather to get men to take enough than urge them to work too long.

As to Sunday trains let the public discourage them and they will not exist.

COMMISSIONERS.—The arguments advanced in favor of the appointment of such a body are not sound, and, moreover, a body clothed with the powers suggested would be simply unable to do the work indicated.

The qualifications which suggest themselves as required by its members are :—

1. Political economist.
2. Financial expert.
3. Commercial expert.
4. Architect.
5. Civil Engineer.
6. Mechanical Engineer.
7. Statistician.
8. Experienced R.R. manager.

When these can be secured in such a body, then it may be desirable to change the present system ; meanwhile the power of the railway committee is quite sufficient to meet any case, especially as all are so easily made amenable to the ordinary law for failure of any kind.

That Mr. Drummond has made an unfair comparison between the accidents occurring in the United States as compared with those in Canada has been clearly proved by Mr. Wallis, and certainly it cannot be said that the appointment of commissions has had the effect in the neighboring States of rendering travel in these States safer than in Canada.

One of the most serious accidents that have occurred for many years took place last summer near Boston, in a State which the author quotes as being a model Railway State, and as having one of the best systems of Railway Commission. He says that the appointment of Commissions has resulted in the safety of the roadway and rolling stock. The accident

referred to was one caused by a defective bridge; the design of which was bad and the inspection of which must have been also defective, or such imperfect construction would have been noted and repaired. In Canada we have never had a single accident arising from a cause so evidently preventable by the exercise of a reasonable amount of oversight. The author states that while the United States are making such improvements in everything conducive to the safety of roadways, bridges and rolling stock, Canada with a contentment that is remarkable, is standing still, and the experience gained by our neighbors is unheeded by us. He has not, however, shewn in what way we are standing still, nor what experience gained by our neighbors we are not profiting by. The speaker has travelled within the last few years, over portions of most of the Trunk lines in the Eastern and Middle States, and has carefully examined the roadway and equipment of these lines. He fails to see in what respect the Trunk lines of Canada are behind those of the United States. Our road-beds are as well built and as well ballasted as those in the United States, and as regards the C.P.Ry., he could only say that the bridges are certainly as safe, in every respect, as those in the United States, and in many respects safer.

As to Overhead Bridges, Tunnels, &c., the Canadian Government requires that there shall be a clear headway of seven feet over the top of the highest car, which height is assumed by the C.P.Ry. to be 14' 6". It must be apparent to any one travelling in the United States that less headway is provided over there than in Canada.

The author lays down certain requirements which all Railways should be forced to provide or to carry out, relating to Guard Rails, Bridge Inspection, Overhead Bridges, Power Brake on Freight Cars, Railing, Couplers, Tools, Testing of Wheels, Air Brakes, Electric Light, Steam Heating, Upper Berths, Tests of Locomotive Boilers, Safety Valves, Blocking Frogs, Level Crossings, &c., &c.

As to Guard Rails on all embankments exceeding a certain height, the author does not fix this height, and it would be difficult to do so, seeing that serious accidents have taken place just as often by running off low as off high embankments, and if Guard Rails are put on embankments it would be necessary to place them along the whole line, which even the author himself would hardly advise.

On the C.P.Ry. double guard rails are put on all bridges, and every bridge is made strong enough to carry a locomotive when off the track as safely as when on the track.

The author has only to examine the floor on the St. Lawrence Bridge lately built by the C.P.Ry., in order to see that Canadian roads

are as fully alive in rendering their bridges as safe as any Railway in the United States under the most vigilant commissioners.

As to Bridge Inspection, the C.P.Ry. has a body of Inspectors who inspect each bridge every month and are constantly going back and forward making careful examinations of them. They have special forms for bridge reports upon which they state the condition of the bridge and give a full and detailed account of the necessary repairs. These Reports are sent to the Head Office where they are entered in a book provided for this purpose, an inspection of which shews the Engineer at a glance the condition of every bridge.

Power Brakes on freight cars will only be possible when all the Railways both in Canada and the United States agree upon a uniform height of cars and a uniform system of brakes, and when this is done automatic couplers will probably be adopted if all the Railway Companies can agree as to which of the many shall be adopted. It is a fact not generally known that very few men are killed in coupling cars, the majority of accidents taking place when the cars are being uncoupled.

In the matter of tools on passenger cars, the C.P.Ry. not only provides tools in each car, but provides a box of tools at the back and front of every train, and in this respect exceeds the requirements of the New York State law to which the author refers.

The question of testing wheels was a very much more important one in old days, and it is even so in the United States at present than it is in Canada, where the trunk lines have not a single cast iron wheel under any passenger car or a locomotive.

In the matter of Electric Light, the C.P.Ry. is quite prepared to adopt it when any system has been devised that will be satisfactory. He knew of one road in the United States which had adopted the Electric Light, but which a great portion of the time has oil lamps burning along with the Electric Light. The oil used on the C.P.Ry. cannot be set on fire even by throwing burning waste into it, so that there is no question of a fire arising from burning oil.

As regards heating, the Canadian Pacific Ry. has hot water heaters in every car, so arranged that in case of an accident the water in the coils would almost invariably put it out. It must not be thought that there is no danger in connection with steam heating, for, to be efficient, a pipe with live steam must be carried either in or through the car, and in case of an accident and the breakage of one of these pipes, the car would in all probability be filled with live steam. It would seem preferable to run the chance of being burnt rather than the certain death that would result from live steam being allowed to escape into a closed passenger car.

Attempts have been made to heat the cars with steam at low pressure, and the front cars are by this means fairly heated, but in a case of a long train the rear cars cannot be made comfortable in this northern climate.

The upper berths of the C.P.Ry. sleeping cars are not only provided with wire attachments to prevent them from closing in case of accident, but unlike most American sleepers they do not close by being pushed into position; they will not close unless the handle is turned.

The frogs used on the C.P.Ry. are all blocked, as are Switches, Guard Rails, etc. Where Railways cross on the same level in Canada the law requires all trains to stop, and he knew of no case in which this law is not carried out (C.P.Ry. = Canadian Pacific Railway).

Mr. Hannaford It appears questionable if the present laws affecting railways, and referring to their inspection, would be improved by a commission whose duty would be to report directly to the Government.

This power is now vested in the Railway Committee of the Privy Council, which sends Government Engineers to examine and report on all questions that may arise, requiring their assistance to explain the position to the Committee.

The speaker has had experience in the working of several of the State Railroad Commissions.

In *Maine*, examinations are made twice each year. These are superficial, and a Report is published, giving the new material used, and general work done.

In *New Hampshire*, examinations of the railway are made only at intervals (and then superficially), it is rarely that the Commission meets, except on the demand of some locality for increased facilities.

In *Vermont*, the inspection is at intervals only, and then superficial.

In *New York State*, the Commissioners do not inspect in detail.

In *Michigan*, the Commissioners attend more to laws regulating railways than to the physical condition of the roads or to the details of structures.

He considered that some of the suggestions made by Mr. Drummond would not be practicable.

That guard rails on embankments between the Main Line rails would be highly dangerous, to derail a train if anything jammed between the rails.

He has always objected to guard-rails on the inside of Main Line rails on bridges for the same reason.

Guard-rails on embankments, on the outside of Main Line rails, would be attended with great inconvenience, and in winter would require removal for purposes of clearing snow, and for shimming.

The Engineer of a railway will always use extreme care in having everything safe, according to his views and experience.

He is of the opinion that in Canada the power vested with the Railway Committee of the Privy Council is much more effective than any State Commission. It is but recently that in the City of Buffalo, N. Y., the State Commissioners failed to meet the public want, and that a bill is now being sought for in Albany to meet the difficulty respecting level-crossings, and to appoint a commission for such purpose. It would seem that the Reports of the State Commissioners, whilst containing much information, lack uniformity, and that practical examination which their position implies, whilst the system in Canada, being vested in the Federal Government, is uniform, and the power of the Railway Committee can be (and has been) increased from time to time as the growing demands of the country require.

Much of what Mr. Drummond states about appliances—patents or otherwise—which he considers applicable to our railways, would be useless and cumbersome. Railways have to apply remedies with great care, and after mature consideration.

The essayist makes statements against the railway management of the Dominion, which are in some respects startling. The proportion of passengers injured and killed is beyond the limits of any figures Mr. Macdougall had ever seen. He had occasion some years ago to look into this subject, in a paper he read before the Royal Scottish Society of Arts, and the proportion then was immensely in favor of Canada. In our country we have no suburban traffic to speak of; in the busy centres of Britain the suburban passenger traffic bears a large ratio to the whole passenger traffic. Suburban and express main line traffic pass over the same rails, with greater immunity from danger and freedom from accident than the traffic of the streets.

This is due to the rigid regulations they have in force in Britain relative to interlocking of signals, and facing points interlocking with signals, as well as to the absence of fire in the trains. Any one who has had experience with the "foot pan" will absolve that innocent article from being a cause of heat far less of fire.

The telegraph system of working trains, in use on the continent, could be easily adapted to a system of interlocked signals. As he is not now connected with railway work, he cannot write with authority on the subject of signals; he would like to remark, however, that he considers the present system of signalling crude in the extreme. The first principle of a danger signal is a man facing a train with his arm at right angles to the *right side* of his body. This is laid down as the foundation of signalling by the British Board of Trade. In this country the arm is

nearly always on the *left side*, and many examples can be produced where it is placed sometimes on the right sometimes on the left. If a semaphore is a warning or a guide to an engine driver he ought to have some uniformity of practice to guide him. The night danger signal is always red, the day danger signal should be likewise uniform.

The question of guard rails which is now so much agitated is a curious revival of a disused custom. About 25 years ago, they were uniformly adopted on bridges and viaducts on the great Scotch Trunk lines; after a few years they fell into disuse as they were looked upon as a source of danger to the wheel. Since the Tay bridge accident they have come into use again, and are placed on the new bridge but not near the rail.

The numerous cases of wheels leaving the rail, and at the points (or switches) in particular, which have been reported this winter, call for some amendment to the present system. The Engineering journals are full of advertisements of switch and signal locking apparatus, but the employment of them does not seem to find favor. It is to be hoped some member whose work lies particularly in track maintenance will now, or in a future paper, give the Society information on these important points. A train should have no difficulty in running through a properly set and guarded "facing point." Hundreds of trains do this daily in Britain.

Many of the other points referring to accidents could be dealt with if there were an organization similar to the English Railway department of the Board of Trade, with officials having the power to compel railway companies to carry out their orders.

On one point he disagreed with the essayist, that of making city and municipal corporations bear the greater share of the cost of forming and watching level crossings and of constructing bridges in cities. He says: "A railway is now rather to be regarded as a greater factor in the public convenience and in the national prosperity, than as a means through which private individuals may be enriched." Such being the case, when a railway helps to build up a city, it in turn builds up the railway. If a railway crosses a street which has been established before the advent of the railway, and in consequence of increased traffic both on railway and street, the public safety is endangered; or if a company has a bridge which has long failed to meet the demands of street traffic passing over it, it is the province of the railway to increase the accommodation of the bridge, and in the case of a level crossing to provide a suitable safe means of traverse. This rule is enforced in Britain where railways are worked as purely commercial enterprises for the profit of the shareholders. The companies are compelled to put up bridges over level crossings, and provide other safeguards for the public

at their own cost. He regretted the example recently set by the city of Toronto in undertaking a costly work, which should really be carried out by the companies themselves.

That such an interest has been taken by the members is very satisfactory. It was hardly to be expected that those who were connected officially with our numerous railways would be in entire sympathy with the objects of the paper, which was written largely in the interests of humanity and rather from the point of view which the public would take.

The main point of the paper has been in part lost sight of by some who have discussed it. Control over railways is needed in the interests of the public, and has to a certain extent been provided for by Parliament. The channel through which this control was intended to be exercised has not proved efficient from causes which are apparent. What is being done to remedy this? The general fact, which must appeal to every one's feelings of humanity, is apparent that both in the United States and Canada large loss of life and injury to persons annually arise in connection with railways from causes some of which certainly can be remedied. Provision exists on the Statute books for investigation into this. What under these statutes is being done in Canada to consider efficient remedies and secure their adoption?

The statistics have been given in the paper to call attention in general terms to the number of accidents, and to the lack of uniformity in and the defective nature of the statistics in the United States, and not to afford a means of comparison between the accidents in the United States and Canada. The smallness of the passenger returns from Canada strongly suggests some way of making up the returns in the railway offices here, different from elsewhere. It seems unaccountable that States, with a population so very much less than that of Canada, should have as large and in some cases an immensely larger passenger traffic, and the result is still surprising even after allowing for the domesticity of the French-Canadians.

Mr. Wallis and Mr. Macklin appear to have overlooked the fact that no comparisons are drawn from the statistics given. Mr. Wallis is correct in so far as he says that the passenger mileage should be taken into account in ascertaining the proportion of accidents to number of passengers carried, but at the same time it is indisputable that even the passenger mileage is an unfair criterion, more particularly as actual facts indicate that suburban travel leads to a very largely increased proportion of injuries and deaths to employees. Though the passenger mileage in Canada is not given in the official returns, Mr. Wallis must

not take that of the Grand Trunk as a criterion for the whole country. The mileage of a large number of the leading railways of the United States shows that in some cases the number of miles travelled is very high (as for instance the Baltimore and Ohio, SS, and the Chicago and Grand Trunk, 85 per passenger during 1886), and yet the actual average number of miles travelled by all passengers in the different States, whose returns have been consulted, varies only from 14 in Massachusetts to 38 in Michigan. The addition of the returns of the Canadian Pacific was supposed by some speakers to increase the miles travelled in Canada to 100 or even 200 miles per passenger, but the speakers gave this as mere conjecture, and quite lost sight of the fact that the bulk of the travel on the Canadian Pacific is in Ontario and Quebec, and that one train each way suffices for all the passengers offered across the continent. It must be remembered that there are fifty roads in Canada, nearly all of them comparatively short lines, and it is the average of the travel on the whole that must be taken.

The statement has been made that the American roads do not make a return all the accidents, leaving the conclusion to be inferred that Canadian roads are more honest in their reports than those of the United States. This is a mere assertion. The American official returns are under oath in most, if not probably all, States, and wherever the details of accidents are given, they include a record of the smashed finger as well as of the dead and permanently disabled.

Though no particular railways have been referred to in the paper, it will readily occur to every one that many useful improvements have already been or are being introduced on leading Canadian lines of railways, and that an earnest effort is being made by them to produce a high standard of efficiency. There are, however, many other lines where this high standard is wanting, and there is no railway official who cannot find on his own road some room for improvement, which will conduce to greater safety of either employees or passengers, though he may be in doubt as to the best form of that improvement. One result of accidents on bridges within the last year, and the enquiries of the railway commissioners into their causes, is that certain new England railway companies, which have had the highest reputation for efficiency, and which never spared expense in attaining that efficiency, have found that notwithstanding all their efforts in the past, some of their bridges, hitherto considered strong, were defective in strength, and required to be thoroughly overhauled.

It has been said that a new country requires cheap railways. It none the less needs safe railways. New roads should be built to a fixed minimum standard in character of road bed, strength of bridges and

capacity of rolling stock, commensurate with the maximum loads and speed to be allowed. Among many railway promoters Government inspection is regarded as very superficial. It has happened on provincial roads that a trip over the line by a member of the local government, in company with some of the railway directors, has not only secured the payment of the government subsidy, but has enabled the railway company without further inspection to open its line for traffic.

The subject of steam heating, referred to by various speakers, is now gradually going beyond the range of mere experiment. It was the general principle and not any particular system which was advocated in the paper. After careful trial, the Boston and Albany and Connecticut Valley, among other roads, have recently decided to equip, the one its whole the other its through, service on this particular principle, and to abolish stoves.

Electric lighting has now been introduced on the Great Northern Railway of England, four whole trains being equipped each with ninety-two lights—two in every compartment—and with forty-four accumulators. The initial cost, however, is £400 stg. per train, and the weight added two or three tons.

The chief aim of the paper is the advocacy of a railway commission. If the Railway Committee effectively exercised even the powers which it possesses, it would be a source of much good; but its members have other duties which properly have prior importance, and do not give and cannot possibly give that extended time and attention which is absolutely required in investigating the various matters which the Railway Act has placed under their jurisdiction. The public—aware of this—seldom take advantage of this tribunal. It is no disparagement of the acknowledged abilities of the members of the Committee to say this. The recent suggestions on this point of the Royal Commission would be an improvement; but it is still a question whether members of the Government, which itself owns and operates railways, can form an impartial tribunal. A commission responsible directly to Parliament would seem more advisable.

There seems to be an impression that a railway commission exercises an unjust interference with private rights, but the fact is forgotten that these private rights in the case of a railway are all obtained from the public through its Legislatures. Besides, as Mr. Brown has stated, corporations and individuals, and he might have added even governments, are none the worse of some supervision. No railway company can claim to be absolutely perfect in the arrangements connected with its business, and infallible in the opinion of its management; and in the nature of things the private interests of the corporation will occasionally

seriously clash with those of the public. Apart from this, however, a properly constituted impartial railway commission is a tribunal of which the railways themselves would take frequent advantage, as in the matter of railways crossing each other, roadway crossings, right of way, municipal taxation, interchange of traffic, parallel railways, and in many other respects.

Mr. Macklin's criticisms are briefly answered by the fact that the Royal Commissioners' Report of January last expressly admits that both the public and the railways have been benefited by the existence of railway commissions in the United States and Great Britain, and recommends the extension of the powers of the Railway Committee, not as a permanent remedial measure but as in the Royal Commissioners' own opinion the best plan, until further experience has been gained of the working of the commissions elsewhere. Further, whilst these Royal Commissioners' enquiry was intended to be chiefly if not almost exclusively into discriminating rates, the report expressly recognizes by its recommendations that investigation into the causes of accidents on railways should be an important function of the Railway Committee. The Interstate Commerce Act, to which also Mr. Macklin refers, is intended to deal it might be said entirely with discriminating rates, does not touch the subject of accidents, and can only affect railways running from one State to another or to a foreign country. The Act, therefore, whilst dealing with one subject which the Railway Commissions in the separate States had not been able to satisfactorily meet, left these State Commissioners' powers practically where they were before.

